CALIFORNIA COAST NEARSHORE PROCESSES STUDY

ERTS-A EXPERIMENT #088

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May 1973

Type I Progress Report for Period March 1, 1973 to April 30, 1973

Prepared for:

Goddard Space Flight Center
Greenbelt, Maryland 20771

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.

4. TITLE AND SUBTITLE

CALIFORNIA COAST NEARSHORE PROCESSES STUDY

5. REPORT DATE
30 April 1973

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT #
ERTS 1 - I - 3

9. PERFORMING ORGANIZATION NAME AND ADDRESS
U. S. Army Engineer District, San Francisco
100 McAllister Street
San Francisco, California 94102

10. WORK UNIT NO.

11. CONTRACT OR GRANT NO.
S-70257-AG

12. SPONSORING AGENCY NAME AND ADDRESS
Mr. Art Fihelly, Code 430
Technical Monitor
Goddard Space Flight Center
Greenbelt, Maryland 20771

13. TYPE OF REPORT & PERIOD COVERED
ERTS TYPE I
1 March - 30 April 1973

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with Earth Resources Programs, Rockwell International, Downey, California

16. ABSTRACT

During the period 1 March-30 April 1973, aircraft and seatruth data was collected simultaneously with three ERTS-1 overpasses. The test cells investigated included Santa Barbara, Monterey Bay and San Francisco. Aircraft sensors were two Hasselblad cameras, a multispectral camera, an Emside 9 channel scanner and an infrared thermal scanner. Thermal patterns at the entrance to San Francisco indicated complex mixing patterns resulting from tidal and nearshore currents. Dye released near the Russian River mouth was analyzed for riverine discharge and sediment transport. Computer programming of ERTS bulk tapes is being used to contour nearshore density differences resulting from suspended sediment.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
Coastal Processes Tidal Currents Sediment Transport	

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
UNCLASSIFIED	UNCLASSIFIED		

MSFC - Form 3292 (Rev December 1972)

For sale by National Technical Information Service, Springfield, Virginia 22151

PROGRESS REPORT TYPE I, NO. III
CALIFORNIA COAST NEARSHORE
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1. OBJECTIVES OF STUDY

Multiple elements under the broad topic of nearshore processes are being studied with airborne and spaceborne sensor data coincident with sea truth. These elements include (1) nearshore currents, (2) estuarine flushing, (3) season river discharges, and (4) nearshore sediment dispersion. These processes are being studied primarily along the central and southern California coast. Sophisticated data processing techniques are being utilized to obtain the maximum information from available data, and to provide correlation and comparison when possible.

2. SUMMARY OF WORK PERFORMED DURING REPORTING PERIOD

During the period 1 March - 30 April, three aircraft flights were carried out simultaneously with ERTS overpasses and seatruth collection. The aircraft flights took place at the Santa Barbara, Monterey Bay and San Francisco test sites. Aircraft sensors utilized were: two Hasselblad cameras, EMSIDE 9-channel scanner, infrared thermal scanner and a multispectral camera. Seatruth collection by the U. S. Army Corps of Engineers and various educational organizations took place during the aircraft and satellite overpasses. This information is now being used in interpretation and calibration of the remote sensor data. Bulk tapes from the ERTS multispectral scanner were processed for enhancement of coastal suspended sediment distribution.

Aircraft flights which had been delayed because of inclement weather during much of January and February were successfully completed in March. The above-average rains along the California coast this spring resulted in excessive runoff and suspended sediment in the nearshore area. Not only were the river discharges increased but the effect of coastal currents and sediment transport were emphasized by the unusual amount of suspended sediment.

The first 70mm Hasselblad camera was configured with Ektachrome film with a Wratten 12 filter. The film was overexposed 1-1/2 stops. These resulting pictures were found to give the most useful information on the current and sediment patterns under investigation. The suspended sediment is emphasized and contrasted with the surrounding clearer water. This brought out the suspensate location, gyre and eddy patterns, and nearshore erosional and dispositional features. The second Hasselblad camera utilized minus blue water penetration film and a K-2 filter. This film does not have a blue sensitive top emulsion layer. The yellow K-2 filter removes blue light to which the emulsions in the cyan and magenta layers are sensitive. As a result, unwanted blue light is decreased in air to underwater photography allowing for greater water penetration sharpness and underwater detail.

The resulting photography shows detail of the nearshore areas which were flown. For example, the longshore movement of sediment along the coast adjacent to Pt. Mugu is brought out in detail. The downward movement of this nearshore material into the two-headed Mugu submarine canyon is illustrated. The minus blue photography also brings out the surface and near surface kelp growth in detail.

The multispectral camera was equipped with narrow band (200 Å) interference filters in the blue through green light spectral region to obtain maximum water penetration for mapping and comparing suspended sediment with bottom features. The broader band (600 Å) EMSIDE scanner was employed to classify and differentiate suspended sediment, oil, kelp and other materials found in the nearshore area. Also, the EMSIDE imagery was employed to recognize color boundaries in the water related to ocean currents and shoreline effluents.

The thermal infrared scanner was used to locate and delineate small temperature differences resulting from effluents, upwelling, downwelling, tidal flushing, wind induced mixing and nearshore current patterns. Infrared imagery collected from the San Francisco Bay area on April 4, 1973 is a good example. A complex pattern of a shallow warm surface layer of water is shown. Ships passing into and out of San Francisco Bay have caused mixing of the cooler near-surface and warmer surface waters. At the time the imagery was collected, it was one hour before high tide and flow lines in the thermal pattern indicates the movement of water under the Golden Gate bridge. A relatively cool water gyre is evident off Stinson Beach and Bolinas Bay which is turning in a counter-clockwise pattern. A complex wind induced shearing pattern is superimposed upon all the other surface features that are illustrated.

The digital processing objectives for this report period were two-fold:

1. Develop the software required to read and process bulk ERTS computer compatible tapes (CCT) to emphasize subtle nearshore suspended sediment.

2. Initiate development effort to interface density values on the bulk tapes with contouring and mapping software packages. This will result in density contours which can be compared from channel to channel and from various overpasses.

A computer program was developed and has been used to read and reformat the NASA ERT-A bulk CCT's to the standard format utilized for both the analog (Flying Spot Scanner - FSS) and digital processing.

Detailed work is now in progress to examine the characteristics of the data in CCT 1109-18233 MB of the Santa Barbara channel to emphasize the subtle nearshore suspended sediments. Radiometric and geographic calibration techniques are presently under investigation to further improve the quality and reliability of the data obtained from the bulk tape data and to insure uniformity of photographic scale. Both photographic (FSS) and digital techniques are being tested.

A parallel effort is underway to develop the software necessary to interface the reformatted tapes with contouring software in use in other research projects. This software is designed to be used in IBM 370 computers which presents start-up, operational and technical problems. All other processing of ERTS-A data is designed for use in a Raytheon 706 Computer Lab. The structure of the software system to be used has been defined and a program has been written to perform the conversion of the reformatted tape data to a data package compatible with the contouring program.

Concurrent with the above described conversion effort, detailed analysis of contouring program output is underway to facilitate the interpretation of the output when ERTS-A data is used as the input. The analysis effort consists primarily of determining the effect on the output when various overlap and contour interval combinations are assigned. This is particularly important because of the narrow range over which sedimentation density levels tend to vary.

Analysis of ERTS-1 images 1235-18075-4 and 1235-18082-4 has allowed for the tracing of the complex transitory nature of the suspended sediments off southern California. These two scenes represent the coastline from San Luis Obispo Bay to Mugu Lagoon and the open ocean to approximately 120 miles offshore. A pattern of surface material is visible stretching for a distance of 110 miles to the southwest from Pt. Conception. This appears to be a combination of material from both the coastal area and the Channel Islands. A southwest vector of the California current has apparently transported this material to form this extensive pattern. Several layers of sediment appear in the area between San Luis Obispo Bay and Pt. Conception. Off Pt. Conception a counter-clockwise gyre is present. South of Santa Rosa Island, two opposite rotating gyres are moving material from south to north. Between Santa Rosa and Santa Cruz Island, a north moving current is evident. From Santa Barbara to Pt. Mugu, material is moving to the southeast by nearshore currents. Out in the Santa Barbara channel, however, an opposite current is mocing material to the west and northwest. This set of ERTS images thus represents a striking example of the far reaching dynamic ocean surface movement which was recorded for later study. This would be impossible by other means.

3. SCHEDULE

The study is progressing as scheduled.

4. WORK PROGRESS

The three underflights simultaneous with the ERTS overpasses during this reporting period brings all phases of this study up to date.

5. RELIABILITY

Emphasis continues to make scientifically correct analyses and interpretations from the ERTS, aircraft and seatruth data.

6. FUNDS

At this time the scheduled funding for this study is adequate to complete the tasks required.

7. PERSONNEL

Personnel remains the same at the time of this report.

8. PLANNED WORK

One aircraft flight is scheduled for the next reporting period, 1 April - 31 May 1973. Two types of 70mm film will be utilized in the multispectral camera during the next flight. Computer processed bulk ERTS data will be interfaced with contouring and ampping software. Processing and interpretation of recent aircraft flight data and ERTS data will continue.

SIGNIFICANT RESULTS

CALIFORNIA COAST NEARSHORE
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Contract S-70257-AG

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Progress Report Type I No. 3 — March 1, 1973-April 30, 1973

Report Category 5H

1. Remote sensor aircraft flights took place simultaneously with ERTS overpasses at the San Francisco, Monterey Bay and Santa Barbara test cells. The sensors utilized were: two Hasselblad cameras, EMSIDE 9 channel scanner, infrared thermal scanner and a multispectral camera. Seatruth data was collected by the U. S. Army Corps of Engineers and various educational organizations. The film/filter configuration in the cameras was: Hasselblad #1 - Ektachrome/ Wratten 12; Hasselblad #2 - Minus blue water penetration film/K-2 filter, and Multispectral camera Tri-X/4500 Å, 5000 Å, 5300 Å, 5800 Å filters. The camera and scanners were configured for detecting suspended sediment and for maximum water penetration.

   The Ektachrome/Wratten 12 photographs which were intentionally overexposed 1-1/2 stops were found to show the most extensive sediment transport detail. Minus blue/K 2 photographs illustrate nearshore underwater bottom details including the head of the Mugu submarine canyon. The EMSIDE 9 channel scanner was employed to classify and differentiate suspended sediment, oil, kelp and other materials found in the nearshore area.

2. Processing of bulk ERTS computer compatible tapes (CCT) was utilized to enhance and analyze nearshore sediments. This technique was most successful in enhancing subtle nearshore features found to be faint or invisible on prints made from the supplied negatives. In addition to this continuing computer process, an effort was initiated to interface density values from the bulk tapes into contouring and mapping software.